REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-8, 10-13, 16, and 18-21 are currently pending, Claims 1 and 2 having been amended, and Claims 3, 4, 6, and 7 having been previously withdrawn from consideration. The changes and additions to the claims do not add new matter and are supported by the originally filed specification, for example, on page 14, line 20 to page 15, line 9.

In the outstanding Office Action, Claims 1, 2, and 5 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada et al. (JP 63-037621, hereafter "Yamada") in view of Hood (U.S. Patent No. 3,510,656); Claim 8 was rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada in view of Hood and Armistead (U.S. Patent No. 5,838,759); Claims 10, 12-13, 16, 18, 20, and 21 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada in view of Hood, Armistead and Cluzeau (French Patent Application FR 2 738 669); Claims 11 and 19 were rejected under 35 U.S.C. §103(a) as being unpatentable over Yamada in view of Hood, Armistead, Cluzeau, and Kassing (German Patent Application DE 3049153 A1).

Applicant thanks the Examiner for the courtesy of an interview extended to Applicant's representative on August 14, 2008. During the interview, the differences between the claims and the applied art were discussed. Further, clarifying claim amendments were also discussed.

With respect to the rejection of Claim 1 under 35 U.S.C. §103(a), Applicant respectfully submits that the amendment to Claim 1 overcomes this ground of rejection. Amended Claim 1 recites, *inter alia*,

> neutron emissive parts and neutron non-emissive parts which are juxtaposed, only the neutron emissive parts containing anthropogenic tritium emitting neutrons during the bombardment with particles, said emissive and non-

> emissive parts being arranged so as to form a non-uniform pattern as a coded mask such that said target emits a neutron flow including plural neutron beams coded by the pattern of the mask.

Applicant submits that the above-mentioned features are fully supported by the originally filed specification, at least on page 14, line 20 to page 15, line 9. In a non-limiting example, the specification describes that tritium is being fixed in the emissive parts 11. Furthermore, Applicant submits herewith an attachment from Argonne Nataional Laboratory ("Tritium," Human Health Fact Sheet, August 2005, hereafter "Argonne"), which supports that tritium has only two origins. It is either naturally present as a very small percentage of hydrogen or it is "anthropogenic," which means that it is produced by human activities such as in a nuclear reactor or nuclear reprocessing plant. Argonne also indicates that for an amount of tritium to be used on a practical scale it must be artificially produced. (See third and fourth paragraphs of Argonne). Thus, Applicant submits that one of ordinary skill in the art would clearly understand that the specification is describing the use of "anthropogenic" tritium because naturally occurring tritium cannot be used as described in the specification in a practical manner.

Applicant's Figures 2 and 4A-4C show non-limiting examples of the features of Claim 1. Figure 2 shows a target 10 that has juxtaposed emissive parts 11 and non-emissive parts 12 forming a coded mask. In this example, the target 10 is bombarded with ions of tritium and deuterium and the emissive parts 11 emit neutrons as a result (see specification at page 10, lines 12-24). Figure 3A shows the resulting flow of neutrons as beams coded by the pattern of the mask on target 10. The emissive parts 11 are made by depositing a hydrogen fixing material 15 through a stencil 16 and forming blocks 17 as shown in Figure 4A (See page 14, lines 5-22). The hydrogen fixing material used to form the emissive parts 11 is fixed with tritium nuclei (see page 2, lines 24-28).

In the above example, anthropogenic tritium is used because an important amount of tritium is required, and as mentioned above natural tritium cannot be used because it is too small an amount. Applicant submits that a target comprising anthropogenic tritium, such as in Claim 1, can produce a neutron flow for a long time, and that the neutron flow can be used in a neutron generating tube or in a particle accelerator.

Yamada is directed to an X-ray mask. In Yamada, Figs. 1a-1c show a boron nitride carbide hydride film 5 is used, which the Office Action interprets as corresponding to the claimed "emissive parts." (See Office Action, at page 3).

The Office Action acknowledges that Yamada fails to disclose or suggest neutron emissive parts that contain tritium. However, during the interview, the examiner indicated that tritium is inherently present in nature, and that the emissive parts of Yamada could be interpreted as containing tritium on that basis. However, the amendment to Claim 1 clarifies that the tritium is "anthropogenic" (i.e., artificially produced). Therefore, if any tritium can be found in Yamada, then it is naturally occurring tritium and not "anthropogenic tritium" as defined by Claim 1. Consequently, in Yamada, the amount of tritium in the boron nitride carbide hydride film 5 is a trace amount, if present at all. Thus, Applicant submits that the device of Yamada cannot be used as a target incorporated in a neutron generating tube or in a particle accelator. Additionally, a person of ordinary skill in the art would not use tritium in the film 5 because Yamada is used to transmit X-rays and not to emit neutrons.

The Office Action relies on Hood to remedy the deficiencies of Yamada with regard to Claim 1 (see Office Action, at page 4).

Hood is directed to an X-ray source which includes a beta-particle emitting radioactive material in the presence of a target material which emits X-rays when bombarded by the beta-particles (see col. 2, lines 6-12 of Hood). The target material is in a gaseous form (see col. 2, line 12). The radioactive material is also in a gaseous form when it is tritium (see

col. 2, line 34). In Hood, the target material and the radioactive material are gaseous and they are confined in a container (see col. 2, lines 13-25). During the operation of the X-ray source of Hood, the radioactive material stays in a gaseous state.

However, the tritium of Hood is used to emit beta particles and the parts 3 of Yamada are intended to be transparent to X-rays. Therefore, a person of ordinary skill in the art would not be motivated to replace the solid parts 3 of Yamada with the gaseous tritium described by Hood because of their different purposes.

The Office Action also takes the position that Hood and Yamada may be combined by "introduction of the X-ray source in a container abutting the window [as described by Hood]," and "[b]ecause tritium inherently penetrates matter, being an isotope of the smallest atom (H), said tritium necessarily also is present in the neutron emissive parts of the Yamada et al invention within the context of said combination." (See Office Action, at page 4). In other words, it appears that the Office Action is asserting that the combination of Yamada and Hood involves placing the X-ray source of Hood within the vicinity of the X-ray mask of Yamada, and that the tritium will inherently penetrate and become part of the neutron emissive parts 3 of Yamada's X-ray mask.

However, Hood describes gaseous tritium in combination with a target material which is also a gaseous one in order to reduce the possible absorption of beta-particles by the radioactive material itself (see col. 2, lines 29-33). Hood does not disclose or suggest to use gaseous tritium to fix it in a solid material to emit neutrons. In Hood, the target material and the radioactive material are gaseous and they are confined in a container. During the operation of the X-ray source of Hood, the radioactive material stays in a gaseous state.

However, Claim 1 defines that "only the neutron emissive parts containing anthropogenic tritium emitting neutrons during the bombardment with particles." In other words, to have the neutron emissive parts contain the tritium, the tritium impregnates the

neutron emissive parts and it is possible to obtain a high tritium density. Applicant submits that such density is not possible with a gas and that the density ratio of the claimed invention over using a gas as described by Hood is superior by approximately 10^6. Therefore one of ordinary skill in the art would not use tritium in a gaseous form in the target of the present application because that would involve a large change of scale in the structure of Hood to achieve a high tritium density.

Therefore, Applicant respectfully submit Hood fails to disclose or suggest the neutron emissive parts containing anthropogenic tritium, as defined by Claim 1.

Thus, Hood fails to remedy the deficiencies of Yamada with regard to Claim 1. Therefore, Applicant submits that Claim 1 (and all associated dependent claims) patentably distinguishes over Yamada and Hood, either alone or in proper combination.

Armistead, Cluzeau, and Kassing have been considered but fail to remedy the deficiencies of Yamada and Hood with regard to Claim 1.

Thus, it is respectfully submitted that amended Claim 1(and all associated dependent claims) patentably distinguish over Yamada, Armistead, Cluzeau, and Kassing, either alone or in proper combination.

Consequently, in light of the above discussion and in view of the present amendment, the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
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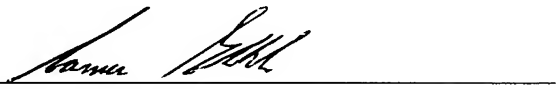

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Tritium (Hydrogen-3)

Symbol:	**H** (H-3)
Atomic Number: *(protons in nucleus)*	**1**
Atomic Weight: *(naturally occurring H)*	**1**

What Is It? Tritium is the only radioactive isotope of hydrogen. (An isotope is a different form of an element that has the same number of protons in the nucleus but a different number of neutrons.) The nucleus of a tritium atom consists of a proton and two neutrons. This contrasts with the nucleus of an ordinary hydrogen atom (which consists solely of a proton) and a deuterium atom (which consists of one proton and one neutron). Ordinary hydrogen comprises over 99.9% of all naturally occurring hydrogen. Deuterium comprises about 0.02%, and tritium comprises about a billionth of a billionth (10^{-16} percent) of natural hydrogen.

Radioactive Properties of Tritium

Isotope	Half-Life *(yr)*	Natural Abundance *(%)*	Specific Activity *(Ci/g)*	Decay Mode	Radiation Energy *(MeV)*		
					Alpha *(α)*	Beta *(β)*	Gamma *(γ)*
H-3	12	<<1	9,800	β	-	0.0057	-

Ci = curie, g = gram, and MeV = million electron volts; a dash means the entry is not applicable. (See the companion fact sheet on Radioactive Properties, Internal Distribution, and Risk Coefficients for an explanation of terms and interpretation of radiation energies.) Values are given to two significant figures.

The most common forms of tritium are tritium gas (HT) and tritium oxide, also called "tritiated water." In tritiated water, a tritium atom replaces one of the hydrogen atoms so the chemical form is HTO rather than H_2O. The chemical properties of tritium are essentially the same as those of ordinary hydrogen. It decays with a half-life of 12 years by emitting a beta particle to produce helium-3. Tritium has a relatively high specific activity and is generated by both natural and artificial processes. It is of concern at Department of Energy (DOE) sites that operated tritium production facilities, such as Hanford.

Where Does It Come From? Tritium is naturally present as a very small percentage of ordinary hydrogen in water, both liquid and vapor. This tritium is produced as a result of the interaction of cosmic radiation with gases in the upper atmosphere, and the natural steady-state global inventory is about 7.3 kilograms (kg). (About five times this amount remains from past atmospheric nuclear weapons tests.) After being produced in the atmosphere, it is readily incorporated into water and falls to earth as rain, thus entering the natural hydrological cycle. Tritium is also produced as a fission product in nuclear weapons tests and in nuclear power reactors, with a yield of about 0.01%. That is, about one atom of tritium is produced per 10,000 fissions. Each year a large commercial nuclear power reactor produces about 20,000 curies (2 grams) of tritium, which is generally incorporated in the nuclear fuel and cladding.

Because little tritium is naturally present, it must be produced artificially for use on a practical scale. Tritium can be made in production nuclear reactors, i.e., reactors designed to optimize the generation of tritium and special nuclear materials such as plutonium-239. Tritium is produced by neutron absorption of a lithium-6 atom. The lithium-6 atom, with three protons and three neutrons, and the absorbed neutron combine to form a lithium-7 atom with three protons and four neutrons, which instantaneously splits to form an atom of tritium (one proton and two neutrons) and an atom of helium-4 (two protons and two neutrons). The United States has recovered an estimated 225 kg of tritium, of which 150 kg has decayed into helium-3, leaving a current inventory of approximately 75 kg. While tritium can also be produced in accelerators by bombarding helium-3 with neutrons, this approach has not been proven on a large scale.

How Is It Used? Tritium is used as a component in nuclear weapons to boost the yield of both fission and thermonuclear (or fusion) warheads. Tritium is also used as a tracer in biological and environmental

studies, and as an agent in luminous paints such as those used to make building exit signs, airport runway lights, and watch dials.

What's in the Environment? Tritium is present in water (liquid and vapor) as a result of natural processes in the atmosphere, as well as from fallout from past atmospheric nuclear weapons tests and the operation of nuclear reactors and fuel reprocessing plants. The form of most concern, tritium oxide (HTO), is generally indistinguishable from normal water and can move rapidly through the environment in the same manner as water. Tritium is naturally present in surface waters at about 10 to 30 picocuries per liter (pCi/L). The maximum contaminant level developed by the Environmental Protection Agency for tritium in drinking water supplies is 20,000 pCi/L or 0.02 microcuries per liter (a picocurie is a millionth of a microcurie). Higher concentrations can be present in water at facilities that produce and utilize tritium, including certain DOE sites.

What Happens to It in the Body? Tritium can be taken into the body by drinking water, eating food, or breathing air. It can also be taken in through the skin. Nearly all (up to 99%) inhaled tritium oxide can be taken into the body from the lungs, and circulating blood then distributes it to all tissues. Ingested tritium oxide is also almost completely absorbed, moving quickly from the gastrointestinal tract to the bloodstream. Within minutes it is found in varying concentrations in body fluids, organs, and other tissues. Skin absorption of airborne tritium oxide can also be a significant route of uptake, especially for exposure to high concentrations of tritiated water vapor, as could occur under conditions of high humidity during hot weather, because of the normal movement of water through the skin. For someone immersed in a cloud of airborne tritium oxide (HTO), the uptake by absorption through the skin would be about half that associated with inhalation. No matter how it is taken into the body, tritium is uniformly distributed through all biological fluids within one to two hours. Tritium is eliminated from the body with a biological half-life of 10 days, the same as for water. During the time it is in the body, a small fraction of the tritium is incorporated into easily exchanged hydrogen sites in organic molecules.

What Is the Primary Health Effect? Tritium poses a health hazard only if it is taken into the body, because tritium decays by emitting a low-energy beta particle with no gamma radiation. This beta particle cannot penetrate deeply into tissue or travel far in air. The most likely form of uptake is as tritium oxide (or tritiated water), as the uptake of tritium gas is typically very low (less than 1%). Tritiated water behaves the same as ordinary water, both in the environment and in the human body. Hence, a significant fraction of the inhaled and ingested tritium is directly absorbed into the bloodstream. The health hazard of tritium is associated with cell damage caused by the ionizing radiation that results from radioactive decay, with the potential for subsequent cancer induction.

What Is the Risk? Lifetime cancer mortality risk coefficients have been calculated for nearly all radionuclides, including tritium *(see box at right)*. The values given here are for tritiated water; additional values are available, including for inhalation and ingestion of organically bound tritium and inhalation of tritium on particulates. As for other nuclides, the risk coefficient for tap water is about 80% of that for dietary ingestion.

Radiological Risk Coefficients

This table provides selected risk coefficients for inhalation and dietary ingestion of tritiated water. Risks are for lifetime cancer mortality per unit intake (pCi), averaged over all ages and both genders (10^{-12} is a trillionth). Other values, including for morbidity, are also available.

Isotope	Lifetime Cancer Mortality Risk	
	Inhalation (pCi^{-1})	Ingestion (pCi^{-1})
Tritium (H-3)	3.9×10^{-14}	4.4×10^{-14}

For more information, see the companion fact sheet on Radioactive Properties, Internal Distribution, and Risk Coefficients and the accompanying Table 1.